

**REMARKS**

The applicants thank the Examiner for the thorough examination of the application. No new matter is believed to be added to the application by this amendment.

**Entry of Amendment**

Entry of this Amendment under 37 C.F.R. §1.116 is respectfully requested because it cancels claims and places the application in condition for allowance. Alternately, entry is requested because this amendment places the application in better form for appeal.

**Status of the Claims**

Upon entry of this Amendment, claims 1-3, 5-8, 12-16, 18-22 and 26 are pending in the application. Claims 4, 9-11, 17 and 23-25 are cancelled. The amendments to independent claims 1, 7, 15 and 19 incorporate subject matter from claims 9, 20 and 25. Support for the amendments to independent claim 8 find support in claim 11 and at page 4, line 25 to page 5, line 1 of the specification. Claim 26 finds support at page 4, lines 21-24 of the specification.

**Rejection Under 35 U.S.C. §102(b) Over Heller (Paragraphs 1-2 of the Office Action)**

Claims 1-3, 5-8, 12-16 and 18-25 are rejected under 35 U.S.C. §102(b) as being anticipated by Heller (U.S. Patent 5,854,169). Applicants traverse.

Independent claims 1, 7, 15 and 19 incorporate subject matter from claims 9, 20 and 25. Independent claim 8 incorporates the subject matter of claim 11. Claim 9 was free of this rejection over Heller, and the incorporation of this subject matter into claims 1, 7, 15 and 19 thus render these claims instantly patentable over Heller. Claim 11 was free of this rejection over Heller, and the incorporation of this subject matter into claim 8 thus renders this claim instantly patentable over Heller. Claims depending upon claims 1, 7, 8, 15 and 19 are patentable for at least the above reasons.

This rejection is overcome and withdrawal thereof is respectfully requested.

**Rejections Under 35 U.S.C. §102(b) Over Murasawa (Paragraph 3 of the Office Action)**

Claims 1, 2, 6-8 12-16 and 18-25 are rejected under 35 U.S.C. §102(b) as being anticipated by Murasawa (U.S. Patent 5,547,823). Applicants traverse.

Independent claims 1, 7, 15 and 19 incorporate subject matter from claims 9, 20 and 25. Independent claim 8 incorporates the subject matter of claim 11. Claim 9 was free of this rejection over Murasawa, and the incorporation of this subject matter into claims 1, 7, 15 and 19 thus render these claims instantly patentable over Murasawa. Claim 11 was free of this rejection over Murasawa, and

the incorporation of this subject matter into claim 8 thus renders this claim instantly patentable over Murasawa. Claims depending upon claims 1, 7, 8, 15 and 19 are patentable for at least the above reasons.

This rejection is overcome and withdrawal thereof is respectfully requested.

**Rejections Under 35 U.S.C. §103(a) Over Murasawa and Eckberg (Paragraphs 4-5 of the Office Action)**

Claims 4, 9-11 and 17 are rejected under 35 U.S.C. §103(a) as being obvious over the combination of Murasawa with Eckberg (U.S. Patent 5,583,195). These claims elucidate the acids that contribute the anionic group of the polymer. Applicants traverse.

**The Present Invention and its Advantages**

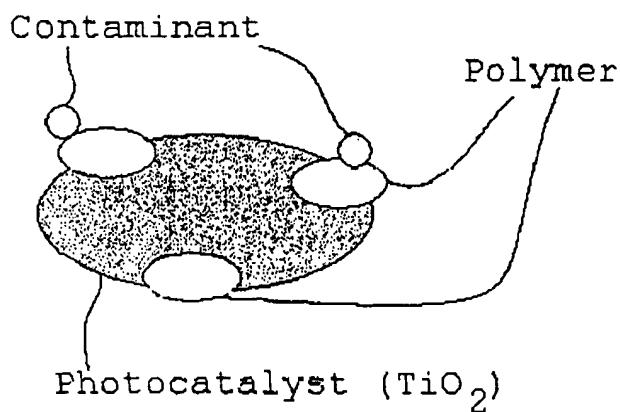
The present invention as is typically embodied in instant claim 1 recites:

1. (Currently Amended) A high-function photocatalyst having its surface partially covered with a polymer having an anionic group, said polymer leaving uncovered photocatalyst surface, wherein the polymer having an anionic group attracts pollutant materials having a positive charge to the photocatalyst surface, and the polymer is selected from the group consisting of poly(fluorine-substituted sulfonic acid), poly(fluorine containing carboxylic acid), polystyrene sulfonic acid, and polyvinyl sulfonic acid, and wherein said partially covered surface is prepared by applying a polymer solution in an amount of 0.05 to 5 ml with a 5% by weight solution to the photocatalyst surface per gram of the photocatalyst.

One of the important features of the present invention resides in that a photocatalyst has its surface **partially** covered by a polymer having an anionic group. In the invention, the anionic group can attract and hold a negative contaminant. Because the photocatalyst's surface is partially covered, when the anionic group traps a contaminant, this contaminant is brought into close proximity with the photocatalyst. The photocatalyst thereby easily and effectively decomposes the contaminant.

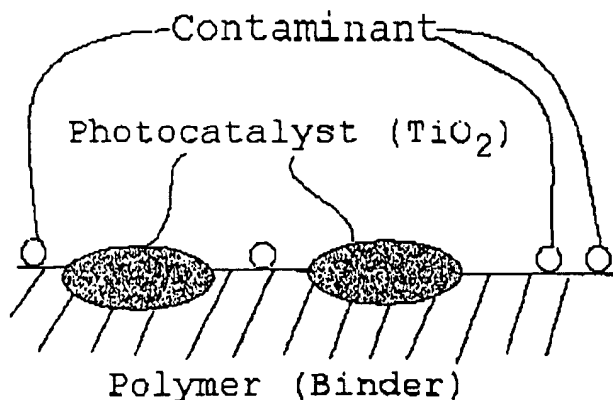
Further, because the polymer has an anionic group, the charge (electron) of the contaminant may transfer to the photocatalyst, whereby a radical may be produced. This radical further accelerates decomposition of the contaminant.

An illustration of an embodiment of the invention is reproduced below.



The above illustration shows that the amount of TiO<sub>2</sub> is significantly large when compared to the polymer. Therefore, when a contaminant adheres to the polymer, TiO<sub>2</sub> in the vicinity of the polymer effectively decomposes the polymer.

In contrast, the conventional art technology is illustrated below.



Here, the contaminant is far from  $\text{TiO}_2$  and is hardly decomposed.

The conventional art illustrated above utilizes an amount of polymer (binder) that is very high when compared to that of  $\text{TiO}_2$ . If a contaminant particle becomes trapped by the polymer, the decomposition effect is unsatisfactory.

Also, the photocatalyst of the conventional art is buried in the polymer so that only a part of the photocatalyst is exposed. As a result, there is only a limited amount of the surface area of the photocatalyst available to react with the contaminants. Accordingly, the small effective area of the photocatalyst results in unsatisfactory decomposition of pollutants.

As follows from the above graphical explanations, the present invention has an optimal concentration of polymer that is lower than that of the conventional art, because the inventive photocatalyst is only partially covered by polymer. The present invention accordingly uses an amount of polymer that is preferably as small as 0.05 to 5 ml in 5% by weight solution per g of photocatalyst (see claims 1,

7, 15, 19). The invention as embodied in independent claim 8 uses 0.1 to 1 ml in 5% by weight solution per 20 cm<sup>2</sup> substrate surface area.

The small amount of polymer leaves most of the surface of the photocatalyst exposed to the environment, and a contaminant trapped by the polymer readily comes into contact with the catalyst.

That is, the present invention by, for example, using the polymer in an amount of 0.05 to 5 ml in 5% by weight solution per g of photocatalyst, cannot cover the entire surface of the photocatalyst, but can only cover a part of the surface. Further, since the photocatalyst is only partially covered, the photocatalyst cannot be buried in the polymer at all.

In contrast, the conventional art uses excess polymer so that most of the photocatalyst is buried or occluded, and little of the photocatalyst is exposed. As a result, there is little charge transfer between the polymer and the photocatalyst. The invention therefore has fundamental differences over the conventional art cited by the Examiner.

*Distinctions of the Invention over Murasawa and Eckberg*

Murasawa pertains to a photocatalyst composite that includes a substrate having particles of titanium dioxide adhered thereon using an adhesive such as a fluorinated polymer or a silicon-based polymer. Murasawa fails to disclose polymers capable of electron transfer and attracting pollution materials (such as an anionic polymer), because Murasawa does not aim at improving catalytic

activity but requires binder to merely fix a photocatalyst onto a substrate. Murasawa further fails to disclose a partially covered photocatalyst.

Accordingly, the sophisticated polymer materials used in the invention are fundamentally different from the simple adhesive materials used by Murasawa. The Examiner recognizes this failure of Murasawa and states at page 5, lines 7-8 of the Office Action: "Murasawa '823 fails to disclose a poly(fluorine-substituted sulfonic acid)."

Further, the present invention uses a sophisticated polymer material such that the photocatalyst has its surface partially covered with a polymer having an anionic group leaving an uncovered photocatalyst surface, and the polymer attracts pollutants. In contrast, Murasawa fails to disclose such a photocatalyst partially covered with a polymer.

Murasawa asserts that their polymers are to maintain adhesion with any substrate without damaging the photocatalytic function (see Murasawa at column 2, lines 24-28). This means that Murasawa considers polymers in a photocatalyst as a catalytic poison to be avoided. Thus, Murasawa teaches away from the subject matter of the present invention.

Further, Murasawa concludes that, as a result of their process, a photocatalyst can be conveniently and easily applied onto various substrates (see Murasawa at column 13, line 47 to column 14, line 3). The present invention, on the other hand, utilizes a polymer having an anionic group to

enhance photocatalytic activity. Accordingly, the superior effects of the present invention is neither taught nor suggested in Murasawa.

That is, the present invention features a photocatalyst that has its surface partially covered with a polymer having an anionic group, and the polymer attracts pollution substances. This feature accomplishes interactions between the photocatalyst surface and the partially covering polymer to thus accelerate catalytic activity. In contrast, as Murasawa'823 fails to disclose any knowledge of a covering portion with a polymer on a photocatalyst, a person having ordinary skill has no motivation to partially cover a photocatalyst with polymer. Murasawa thus fails as a basis for alleging *prima facie* obviousness.

The Examiner then turns to Eckberg for teachings pertaining to coatings of fluorosulfonic acid polymer.

Eckberg pertains to a process for producing epoxysilicon films. Eckberg fails to teach or suggest photocatalysts. The teachings of Eckberg are thus from a fundamentally different field from the invention, and one having ordinary skill in the art would have no motivation to turn to Eckberg when seeking photocatalytic technology. Eckberg is thus non-analogous art.

Also, Eckberg fails to address the deficiencies of Murasawa'823 in teaching or suggesting a photocatalyst, which is partially covered by a polymer having an anionic group, and which attracts a substance, e.g., a pollutant, having a positive charge to a photocatalyst surface.



Thus, one having ordinary skill in the art would not be motivated by the teachings of Murasawa and Eckberg to produce a claimed embodiment of the invention. A *prima facie* case of obviousness has thus not been made. This rejection is overcome and withdrawal thereof is respectfully requested.

### **Prior Art**

The prior art cited but not utilized by the Examiner indicates a status of the conventional art that the invention supercedes. Additional remarks are accordingly not necessary.

### **Information Disclosure Statement**

Applicants thank the Examiner for considering the Information Disclosure Statement filed June 7, 2001 and for making the initialed PTO-1449 form of record in the application in the Office Action mailed November 19, 2003.

The Examiner is respectfully requested to consider the Information Disclosure Statement filed June 16, 2004 and to make the initialed PTO-1449 form of record in the application in the next official action.

### **Foreign Priority**

The Examiner has acknowledged foreign priority in the Office Action mailed November 19, 2003.

**Conclusion**

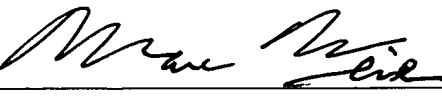
Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert E. Goozner, Ph.D. (Reg. No. 42,593) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

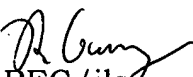
Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicant(s) respectfully petition(s) for a two (2) month extension of time for filing a reply in connection with the present application, and the required fee of \$430.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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